

# The Application and Evaluation of Peritoneoscopy

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## SUMMARY

*Peritoneoscopic examination has now been accepted throughout the world as a safe diagnostic procedure in lieu of laparotomy in selected cases.*

*Laparotomies for diagnostic purposes alone should be condemned.*

*Peritoneoscopy should not be done without a definite purpose and the procedure should not be expected to accomplish more than the purpose for which it is done. Indications for the procedure are set forth in detail. Experience has established definite contraindications, which are reviewed.*

*The procedure is especially indicated for patients who are aged, emaciated, anemic, or poor surgical risks for any reason.*

*All patients having ascites of undetermined cause should be examined by peritoneoscopy.*

*The method is especially indicated for examination of patients with liver disease of all types, for pelvic examinations, for use to determine existence of ectopic pregnancy, and for tumor localization.*

*Considerable use was made of the procedure during World War II to determine the extent and site of intra-abdominal injuries caused by crushing, explosions, and falls from high places.*

*The procedure permits early and correct diagnosis, early decision as to the advisability of operation, and determination as to operability in cases of malignant gastric lesions. It is a safe method for obtaining biopsy specimens from intra-abdominal tissue and organs.*

*Accuracy of diagnosis in cases in which the method can be used is considerably greater with peritoneoscopic examination than with clinical information alone.*

**P**ERITONEOSCOPIC examination is a means of visualizing the peritoneal cavity with an optical instrument. The instrument used is such as to permit the removal of biopsy specimens of tumors or tissues suspected of being diseased. Now a definitely established diagnostic procedure, peritoneoscopic viewing has been accepted generally as another endoscopic method of examining body cavities. It is used to obtain augmentative information when clinical, laboratory and roentgenographic findings are not sufficiently clear-cut for a positive diagnosis.

Although it is the procedure of choice for intra-abdominal examinations in many circumstances, peritoneoscopy cannot wholly supplant laparotomy for this purpose, not only because its usefulness is limited to the visually accessible regions of the peritoneal cavity but also because in some conditions the procedure is definitely contraindicated. Within the limits of its usefulness, however, it offers a valuable extension of the internist's armamentarium while avoiding the greater risks and difficulties of the alternative exploratory laparotomy.

## VALUE OF METHOD

The value of peritoneoscopy lies in the ease of its application and the differential diagnostic information obtained through this safe, direct, eye-controlled method of examination. Through use of the procedure it is often possible to make a diagnosis in a questionable case correctly and without delay, to decide early the advisability of operation upon a patient showing grave disease, and to differentiate tumor masses from various organs in the peritoneal cavity. It offers a simple way of determining operability in cases of malignant gastric lesions. Because it is a far less formidable procedure than exploratory laparotomy for diagnostic purposes, it is particularly useful for patients who are elderly, emaciated, anemic, or for other reasons poor surgical risks. Moreover, the cost is relatively low.

## USES OF PERITONEOSCOPIC EXAMINATION

The indications for peritoneoscopic examination are identical to the purposes for which it is done. These may be listed as follows:

1. Differential diagnosis.
2. Determination if metastases are present.
3. Corroboration of diagnosis.
4. Differentiation and localization of tumor masses.
5. Biopsy.
6. Pelvic examinations.
7. To drain abscesses or cysts and guide exploratory needling.
8. To determine sex (when external genitalia are not distinctive).
9. To determine operability of a lesion.
10. To determine extent of intra-abdominal injuries.

Unfortunately, many of the diagnostic methods that are in use today for making intra-abdominal diagnoses permit only vague and presumptive conclusions.

It is true that, by means of x-ray, a diagnosis may be made of intragastric lesions or lesions that affect the continuity and contour of the gastrointestinal

tract. The roentgenologist often can say whether a tumor is extragastric or intragastric, and in most cases he can indicate the probability of malignancy of the lesion. In such cases peritoneoscopic examination is a valuable aid in determining operability and prognosis.

In cases of ascites the internist, by correlation of the findings and examination of the fluid, can make only a presumptive diagnosis of cirrhosis, malignant growth, tuberculosis or other causes. All patients having ascites of undetermined origin should be given the benefit of peritoneoscopic examination. Ascitic fluid may be withdrawn through the instrument, the peritoneal cavity may be visualized immediately after withdrawal, and biopsy specimens may be taken from any lesion found. The procedure may be curative in cases of ascites caused by tuberculous peritonitis, since the air is left in the abdominal cavity following examination.

Tumor masses are often encountered in the abdominal cavity, and a question arises as to whether they are cysts, abnormal lobes of the liver, retroperitoneal tumors, or malignant growths. Examination by peritoneoscopy can supply the answer.

Mental disorientation, albuminuria, hypertension, cardiac decompensation, diabetes, unconsciousness, or deep jaundice are not contraindications for peritoneoscopic examination. It is assumed that care will be exercised in all cases regarding the preoperative medication given.

There are many instances in which negative findings are valuable to the clinician. Hence, applying the method to an apparently normal abdomen often is justified.

The procedure is especially indicated in all types of liver diseases, in pelvic examinations, in determining ectopic pregnancies, and for purposes of tumor localization.

At times it is helpful in determining the sex of a child if the external genitalia are not distinctive. This becomes important to the parents with regard to a name and the future of the child as a girl or boy.

Following explosions, crushing injuries, or falls from high places, peritoneoscopic examination may be a life-saving measure in determining the nature and site of intra-abdominal injuries. Usually the patient is unconscious, with multiple fractures of bones, and early differentiation of hemoperitoneum from ruptured liver, spleen, or bowel may be of vital importance. There was considerable use of the procedure for this purpose during the recent war.

#### SELECTION OF CASES AND CONTRAINDICATIONS

Because there are physical limits to its usefulness plus a number of very definite contraindications for the procedure, all patients considered for peritoneoscopic examination should be carefully previewed by the peritoneoscopist and the procedure proscribed if it entails risk to the patient or if the purpose for which its use is intended is anatomically impossible of accomplishment. As lesions inside a viscus or those which are buried deep in the peritoneal cavity

cannot be visualized, patients having symptoms localizing the disease in these locations should not be selected. Nor can the duodenum, the common bile duct, the pancreas or kidneys be visualized. Peritoneoscopic examination should not be undertaken as an aid in diagnosis of gastric lesions until a thorough roentgen study has been made, and then only to obtain a biopsy specimen or to determine the extent of the lesion or the presence of metastases. Although the kidneys cannot be viewed, tumors of the kidney often appear as retroperitoneal masses in the abdominal cavity and as such are visible through the peritoneoscope. This is likewise true of pancreatic and omental cysts.

Acute abdominal conditions, obstructive lesions in the large or small bowel, and dilatation of the stomach are all definite contraindications to the procedure, as are operative scars on the abdomen, history of chronic tuberculous peritonitis, and infectious dermatitis of the abdominal wall. The procedure is technically difficult if the patient is obese.

In chronic illness, peritoneoscopic examination should not be done until the usual clinical and laboratory methods for making a diagnosis are exhausted.

#### INSTRUMENTS AND TECHNIQUE

An instrument which has been developed for peritoneoscopic examination consists of six parts and is known as the Ruddock peritoneoscope.

1. Sheath.
2. Bistoury-tipped obturator.
3. Telescope (14 inches) made to fit air-tight into sheath.
4. Biopsy forceps with special telescope.
5. Fluid evacuator.
6. Pneumoperitoneum needle, and a special Reh-fuss tube with an electric light at the tip.

The procedure is carried out in an operating room with strict aseptic technique. The patient is placed on an easily adjustable operating table and draped as is customary for laparotomy.

A local anesthetic is used, and any point in the abdominal wall may be selected for puncture, although the one usually chosen is approximately one inch below the umbilicus in the mid-line. The point of entry must be as far distant from operative scars as practicable.

After local anesthetization, the pneumoperitoneum needle is inserted and the abdomen tightly distended with ordinary unfiltered air pumped in with a baumanometer bulb. The trocar is then inserted, the bistoury-tipped obturator is replaced by the telescope, and the contents of the abdominal cavity are visualized and examined. It is important to keep the cavity distended with air during the entire procedure in order to insure good visualization. If fluid is present it must be removed before visualization is attempted.

Sensitive areas are not encountered in the abdominal cavity during examination, except for the under-surface of the diaphragm and the parietal peritoneum. Since movement of the instrument causes

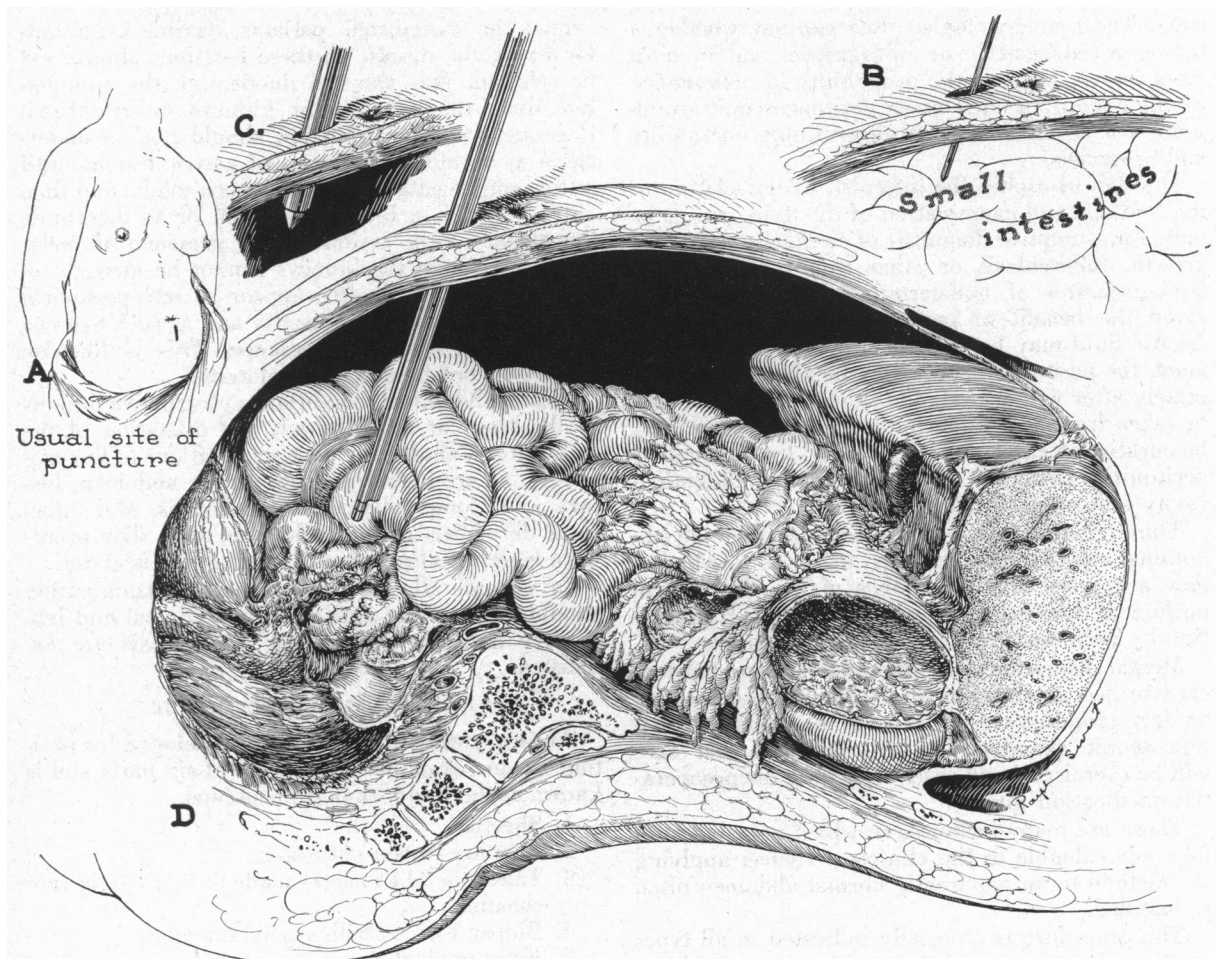


Figure 1

no discomfort if these areas are avoided, the entire abdominal cavity can be explored with a single puncture. Distention with air is not unpleasant, the patients often saying only that they "feel full." Aside from localized subcutaneous emphysema in the abdominal wall at the site of the puncture, and occasionally emphysema of the omentum, no untoward effects have been noted following distention of the abdominal cavity with air. As air makes a perfect visualizing medium, there is no distortion or aberration and objects appear in their natural proportions and color. The lens has a universal focus and the field of vision is in direct ratio to the distance from the object.

As the procedure is technical, the operator must train himself in the details of the method and familiarize himself with the instrument and its use. He should be able not only to recognize and differentiate the macroscopic appearance of normal and diseased tissues, but in addition should be familiar with the anatomical and topographical relationships of the organs within the peritoneal cavity.

The peritoneoscopist should make an examination with a fixed plan in mind which is varied only in relation to the purpose of examination. A general

complete examination of the abdominal cavity, with recognition of organs and landmarks, should be done first. Minute examination of any abnormalities noted then may be undertaken. Biopsy specimens may be taken from organs or tumor growths.

Generally the causes of failure in peritoneoscopic examination are:

1. Lack of basic knowledge of anatomy, pathology, and physiology.
2. Improper technique of examination.
3. Incorrect interpretation.
4. Incomplete examinations.
5. Lack of familiarity with instrument.
6. Poor selection of cases.

#### VISUAL EXAMINATION

The macroscopic appearance of living tissue is quite distinctive and differs considerably from the appearance in the cadaver. Peristalsis, pulsating vessels, movement of the diaphragm, and living tissue may be viewed. With the patient in a horizontal position, the operator has a full view of all the organs in their normal relationship within the peritoneal cavity. The liver, after air insufflation, falls away from the diaphragm and can be examined in

regard to size, shape, color, movements, and nodules. The edges can be followed and the gallbladder noted under the edge of the right lobe. If the spleen is enlarged, it can be seen. The omentum can be moved with the tip of the instrument so that the coiled intestines can be seen. By changing the position of the patient, and manipulating organs by pressure through the abdominal wall or through the vagina and rectum, the operator can bring all the pelvic organs and the appendix into view. Transillumination of the abdominal wall reveals dilated blood vessels as often seen in cases of cirrhosis.

The value of the procedure can be enhanced in some cases by combining it with gastroscopic and proctoscopic examinations. Both examinations may be conducted simultaneously so that each operator may see the transillumination from the light of the other. In some cases valuable information may be gleaned from this procedure.

#### EXAMINATION OF INFANTS AND CHILDREN

When peritoneoscopy is applied to infants and children, the same instruments are used, and the same procedure and technique are followed, with the following exceptions:

1. General anesthesia is necessary.
2. The puncture is always made through the belly of the rectus muscle in order to avoid the possibility of producing hernia.

Transillumination of the abdomen of the infant is particularly striking and the abdominal organs are easily visible because the omentum is small or completely absent. There are three purposes for peritoneoscopic examination of infants: (1) For differential diagnosis and determination of liver disease; (2) for determination of sex, and (3) biopsy.

#### BIOPSIES

Since the high-frequency current makes it possible to cut, coagulate tissue and induce hemostasis, biopsy specimens can be safely obtained through the peritoneoscope sheath. A parrot-beaked rongeur forceps with a special telescope which keeps the forceps under continuous vision has been devised for taking specimens from organs and tissue within the abdominal cavity. The tip of the biopsy forceps is so arranged that, when closed, it forms a cup containing the tissue material. This tip is connected with the high-frequency current and acts as an electrode for coagulating the wound resulting from excising the biopsy specimen. The biopsy material is not affected by the coagulation current.

Biopsy specimens are not taken directly from the tissues of a hollow viscus or from any part of the abdominal cavity in which there is hazard of perforation, but specimens are easily obtained from solid masses such as malignant growths or from solid organs. Biopsy specimens from the spleen

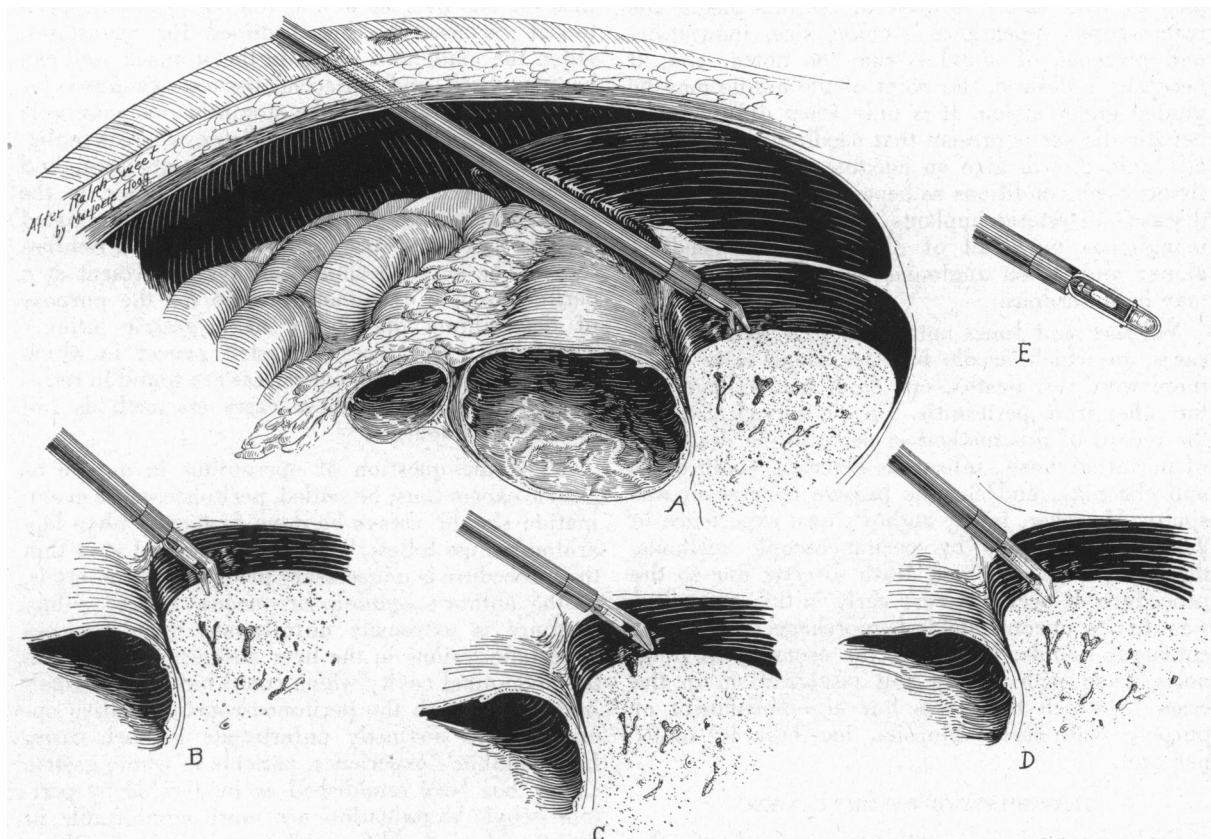


Figure 2

rarely give information of value and, because of the hazard of hemorrhage, should not be taken.

Figure 2 graphically explains the technique which is followed in obtaining biopsy specimens from the liver.

There are three methods in use for obtaining biopsy specimens from the liver, namely, laparotomy, peritoneoscopically directed biopsy, and needle biopsy. Selection of method should be governed by the nature of the case in which it is to be used.

Laparotomy is not justified if an adequate sampling of liver tissue can be obtained by either peritoneoscopic or needle biopsy, although occasionally it is the only method that will serve.

Because peritoneoscopic examination is not painful, it is not difficult to induce a patient to permit a second or third examination if that is necessary to follow the progress of intrahepatic disease. Once the liver has been visualized, needle biopsies may be used as follow-ups.

Seldom in the author's series of 2,500 cases was there failure to visualize metastatic nodules involving the liver, and this should be weighed against the difficulty of hitting single metastatic nodules by needle puncture without visualization.

Since the needling is done for the purpose of probing for deep abscesses or to obtain tissue deep below the surface, it is the author's opinion that, unless contraindicated, a peritoneoscopic examination should be done in all cases when a biopsy specimen of liver tissue is desired. By this means the macroscopic appearance—color, size, induration, and presence of nodules—may be noted, and, if needling is desired, the point of the needle may be guided under vision. It is only when diffuse intrahepatic disease is present that needling, unless visually guided, will give an adequate sample of liver tissue. Such conditions as *hepar lobatum*, polycystic disease, metastatic implants, perihepatitis, and hemangiomas may fail of diagnosis with needling alone; and, when angiomas are present, needling may be hazardous.

Volwiler and Jones noted that in a series of 174 cases, in which needle biopsies alone were done, there were two deaths, one from hemorrhage and the other from peritonitis. They observed also that the record of this method in determining diagnosis of portal cirrhosis, infectious hepatitis (both acute and chronic), and chronic passive congestion was spotty. However, in the author's own experience in 2,500 examinations by peritoneoscopic methods, there has been only one death directly due to the procedure. It occurred very early in this series and was due to uncontrollable hemorrhage from a sarcomatous nodule. Moreover, the accuracy of diagnosis made with biopsy and visualization, in the cases in which there was low accomplishment of purpose with needle biopsies, has been 95 to 97 per cent.

#### OPERABILITY OF GASTRIC CANCER

Early diagnosis is essential to a reduction in the high mortality rate of cancer of the stomach. By the

time the patient presents a classic picture of gastric tumor, not much hope is left. Clinical methods, and particularly roentgenologic studies, are diagnostically accurate in approximately 95 per cent of cases, but decision as to operability in cases of gastric carcinoma is frequently difficult. Often exploratory laparotomies are undertaken to settle the question. However, it is found that in these explorations to determine operability of gastric carcinoma, the operative mortality rate is approximately 6 per cent, and it is further found that in only 25 per cent of those cases in which operation is performed is the lesion operable.

Decision as to operability becomes difficult when no metastases are demonstrable in the skin, glands, lungs, or bones. Because only the interior of the stomach may be visualized with the gastroscope, that instrument is of no help in such cases. When a gastroscopist states that a lesion is inoperable, he must assume that it has extended or metastasized widely. No safe, easy method for taking a biopsy specimen within the stomach has yet been devised.

There are three factors that help in determining the operability of gastric cancer:

1. Metastases in the liver.
2. Extension to adjacent tissues and peritoneum.
3. Extent of the stomach involved.

These questions can be answered in a high percentage of cases by means of peritoneoscopic examination. The liver as well as the omentum and peritoneal surfaces can be examined for metastases. Often the malignant lesion in the stomach wall can be visualized and adjacent tissues examined for extension. By inflating the stomach, one may note that unaffected stomach wall dilates, whereas malignant infiltration causes it to be non-elastic and leathery. Peristaltic waves can be followed to the lesion, and the stomach wall may be transilluminated by means of an electric light on the end of a Rehfuß tube. (The surgeon should always be present at a peritoneoscopic examination done for the purpose of determining operability of a gastric lesion.) There are a few cases of gastric cancer in which the only extension and metastases are found in retroperitoneal nodes. In these cases all methods fail except laparotomy.

When the question of operability in a case of gastric cancer must be settled, peritoneoscopic examination should always be done first even when laparotomy must follow. The often expressed view that this procedure is unnecessary prior to laparotomy is, in the author's opinion, erroneous. Indeed a laparotomy is extremely unfortunate if it discloses metastatic lesions in the liver and elsewhere within the abdominal cavity which could have been visualized simply with the peritoneoscope. Palliative operations are distinctly unfortunate in such cases. In the author's experience, patients in whom gastric cancer has been established as inoperable by peritoneoscopic examination are more comfortable in the short period of life which remains than are those whose condition has been determined by laparotomy.

## COMPLICATIONS AND ACCIDENTS

Puncture of a viscus is a complication that may confront anyone attempting peritoneoscopic examination. Ordinarily the intestines will recede or slip aside before the trocar, and a viscus is punctured only when it is firmly fixed by adhesions or is tensely dilated. Such punctures have occurred eight times in the author's series of 2,500 cases, all within the first 900 of the total number. Such an occurrence can be avoided by (1) careful examination of the patient before attempting the procedure; (2) selection of a point of puncture to avoid all operative abdominal scars; (3) using bistoury plungers with dull tips; (4) perfection of technique; (5) making sure the stomach and the bladder are empty and collapsed at the time of examination.

Minor complications have occurred a number of times, such as hematoma at the site of the puncture, bleeding from the puncture wound, and subcutaneous emphysema. Hernias have not occurred.

If the patient is kept flat in bed and not allowed to sit or to raise his head for 24 hours following the procedure, no shoulder pains will occur. No cases of air embolism have been noted. In one patient with congenital absence of a portion of the diaphragm, pronounced emphysema of the neck resulted.

There have been no cases of peritonitis resulting from peritoneoscopic examination in this series, but in a few there has been minor cutaneous inflammation around the single stitch applied.

Three deaths have occurred. One, caused by hemorrhage following removal of a biopsy specimen from a sarcomatous nodule in the liver, could have

been avoided by more careful observation of the patient during the eight hours following the procedure. Another occurred following an uncontrollable hemorrhage which resulted from removal of a biopsy specimen from the spleen. In this case the surgeon elected to remove the spleen and the patient died at the time of its removal. The third death occurred in these circumstances: Following peritoneoscopic examination, the abdominal puncture wound was left open to permit continuous drainage of ascitic fluid. When a tongue of omentum was found to be protruding through the wound a few hours later, the surgeon elected to do an abdominal laparotomy to replace it. The patient died of general peritonitis four days later. It is evident from the more recent data on the author's series that these hazards no longer arise.

## ACCOMPLISHMENT OF PURPOSE

In considering data on the accomplishment of the purpose for which peritoneoscopy is done, careful selection of cases in the light of the previously listed

TABLE 3.—Types of Cases (Series of 1,500).

Infants and children.....	24
Males .....	739
Females .....	813
Patients with ascites.....	679
Patients with jaundice.....	293
Biopsy specimens obtained from organs and tissues.....	569

The following conditions were noted and diagnosed: General carcinomatosis of the peritoneal cavity, carcinomatous nodules in the liver, carcinoma of the gallbladder, malignant melanoma of the liver with metastases to the peritoneum, hemangioma of the liver, tuberculosis of the liver, Hodgkin's disease, lymphatic leukemia, lymphatic leukemic infiltration of the liver, acute and subacute alcoholic cirrhosis, atrophic cirrhosis (Laennec's type), Banti's disease, passive congestion of the liver, dislocation of the liver, hepatoma, cysts of the liver, hepar lobatum, frosted livers, abscesses (single and multiple), biliary cirrhosis, hydrops of the gallbladder, chronic cholecystitis, pericholecystitis, lymphoma of the stomach, leiomyoma of the stomach, carcinoma of the stomach, fibroid tumors of the uterus, absence of uterus, atrophic uterus, normal pregnancies, ectopic pregnancies (ruptured), ovarian cysts, ruptured chocolate cyst of the ovary, papillary cystadenoma of the ovary with metastases, carcinoma of the ovary, hydrosalpinx, chronic tuberculous peritonitis, enlarged spleen, perisplenitis, pancreatic cysts, omental cysts, calcified lymph glands, carcinoma of the colon, carcinomatosis of the peritoneal cavity, normal appendix, retrocecal appendix, intra-abdominal hemorrhage, collateral circulation in cases of cirrhosis, eversion of diaphragm, mesenteric laceration from trauma, hernia, ruptured livers and spleens.

TABLE 1.—Accomplishment of Purpose

Purpose	Accomplished	Not Accomplished	Total Cases
Differential diagnosis.....	796	20	816
Determination of tumor.....	81	1	82
Determination of metastases.....	158	1	159
Corroborating diagnosis.....	325	5	330
To determine ectopic pregnancy	88	0	88
To determine ruptured viscus....	2	0	2
To obtain a biopsy.....	9	0	9
For pelvic examination.....	5	0	5
To determine sex.....	2	0	2
Operative procedures.....	7	0	7
	1,473	27	1,500

TABLE 2.—Analysis of Cases in Which Purpose Was Not Accomplished  
(27 cases in a series of 1,500)

Purpose	Perforated Viscus	Adhesions		Fat		Emphysema
		No Entry	No Vision	No Entry	No Vision	
Differential diagnosis .....	6	8	1	3	1	1
Determination of tumor.....	—	—	—	1	—	—
Corroborating diagnosis .....	3	2	—	—	—	—
Determination of metastases.....	1	—	—	—	—	—
Totals .....	10	10	1	4	1	1



TABLE 4.—Comparative Accuracy of Clinical and Peritoneoscopic Diagnosis

Disease	No. Cases	Clinical Error	Peritoneoscopic Error	Clinical Accuracy	Peritoneoscopic Accuracy
Tuberculous peritonitis.....	51	47 %	14 %	53 %	86 %
Peritoneal metastases.....	129	26.3%	6.2%	73.7%	93.8%
Cirrhosis.....	318	26.5%	4.4%	73.5%	95.5%
Malignancy of liver.....	224	44.1%	6.3%	55.8%	93.7%
Ectopic pregnancy.....	58	50 %	None	50 %	100 %
Total clinical accuracy.....		61.4%			
Peritoneoscopic accuracy.....		93.6%			

uses of the method should again be emphasized. The procedure should be used only for a preestablished purpose; if the purpose is accomplished, then the examination is successful and justified.

In Table 1, the statistics available from 1,500 examinations show the high percentage of cases in which the purposes of the examination were accomplished. In Table 2 an analysis is made of the 2 per cent of cases in which the purposes were not accomplished.

The author has made peritoneoscopic examinations for diagnostic purposes in over 2,500 cases. The examinations were done upon patients from the diagnostic service of a large general hospital, upon patients in private practice and upon patients in military service. The age range was from six months to 85 years, and there were about as many males as females. Approximately 1,000 biopsy specimens were obtained. In about half the cases, ascites was present. One third of the patients examined were

proven to have malignant lesions, either metastatic or primary. Table 3 shows other features of the cases studied.

#### DIAGNOSTIC ACCURACY

The compilation of statistics in order to compare the accuracy of diagnoses by clinical methods with the accuracy of peritoneoscopic diagnosis is exceedingly difficult. Comparison is especially difficult when a patient with four or five clinical diagnoses is referred for peritoneoscopic examination. One of the clinical diagnoses may be correct, the others may be wrong, and the peritoneoscopic diagnosis may be right or wrong, or all may be wrong. Careful records have been kept in an attempt to measure the accuracy of clinical diagnosis (with all ancillary methods and laboratory examinations at the clinician's service) against peritoneoscopic accuracy.

Table 4 shows the relative accuracy, thus determined, as regards the diagnosis of a few selected pathologic conditions.

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